PROGRAMMING GUIDE

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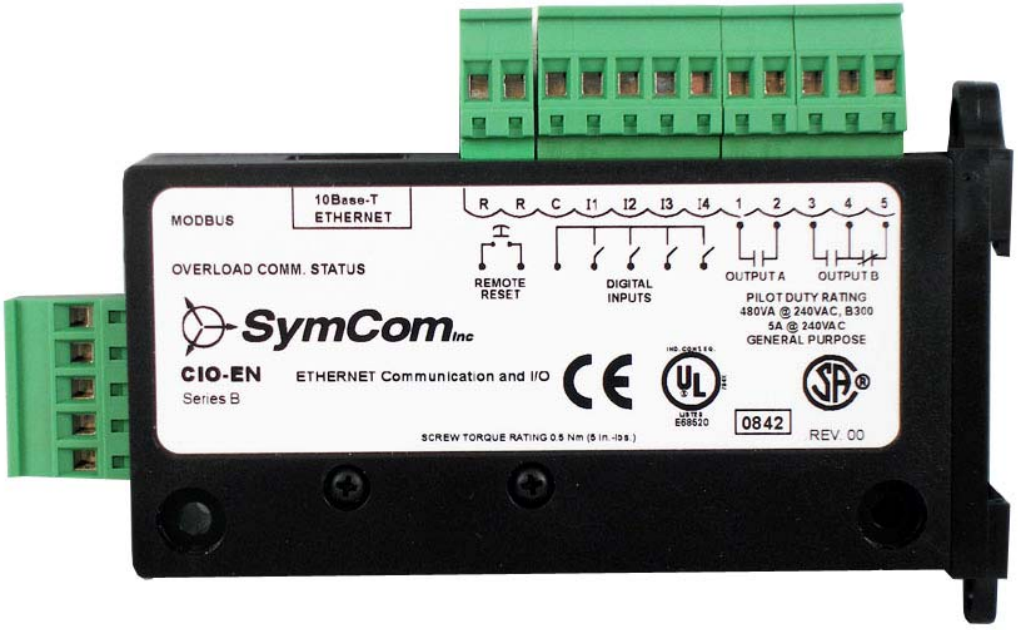
MODEL CIO-EN

MODBUS/TCP, MODBUS/RTU I/O MODULE



PG-CIO-EN-B

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Document Overview

This guide is addressed to systems integrators who will be developing software for a Modbus master device to communicate with the CIO-EN family of products. Experienced Modbus programmers should note that Table 2 contains the CIO-EN memory map. Because the CIO-EN provides the ability to work in conjunction with the SymCom 777-P/P1 overload, Appendix A – 777-P/P1 Modbus Memory Maps contains the 777-P/P1 memory map. All 777-P/P1 Modbus registers are accessible through the CIO-EN. The *Modbus/RTU Protocol on an RS-485 Network* section details programming the CIO-EN using Modbus/RTU, whereas the *Ethernet Configuration* section describes the Ethernet capabilities of the ECIO-EN.

A Modbus master device for this application is typically a Programmable Logic Controller (PLC) or a Personal Computer (PC) that provides the ability to communicate with one or more slave devices. A majority of PLCs have the Modbus command protocols and Cyclic Redundancy Check (CRC) word calculation routines built into them; personal computers do not.

Most master controllers must be programmed to periodically poll the slave devices for data and initiate write requests. Once the CIO-EN responds to a request, the master controller is responsible for determining that the information arrived correctly with no communication errors. The master controller is responsible for reissuing commands to the slave device if there has been a communication error or time-out waiting for a response. The master controller is also responsible for processing valid received data and displaying it to an operator, if applicable.

Modbus/RTU Protocol on an RS-485 Network

The CIO-EN uses the Modbus protocol in Remote Terminal Unit (RTU) mode to receive commands and send information as a slave device on an RS-485 network. The RTU mode essentially means that the characters sent between master and slave devices are binary numbers and not ASCII digits.

In RS-485, a differential voltage signal is used to represent the zeros and ones. The RS-485 standard allows a single network to contain up to 4000 feet of shielded twisted-pair network cable. The cable only needs to be 22 or 24 gauge to transmit 4000 feet at 9600 baud.

The Modbus standard allows for up to 255 devices on a single RTU network. However, it is difficult to scan more than 20 or 30 devices in a timely manner.

Special Hardware

The CIO-EN was designed to operate seamlessly with SymCom Model 777-P/P1 overloads, adding RS-485 and Ethernet functionality to the 777-P/P1. As an important note, the nine-pin connectors on the Model 777-P/P1 and CIO-EN are NOT RS-232 connectors! The CIO-EN provides electrical isolation from the high voltages present in the Model 777-P/P1.

The Model CIO-EN provides two important functions when connected to a 777-P/P1. First, the module electrically isolates the communication network from the high voltages present in the Model 777-P/P1. Secondly, the CIO-EN converts the communication signals from the microcontroller's 5 volt levels into RS-485 levels. More information about the 777-P/P1 overloads can be found in the respective programming guides and installation manuals, located at www.symcom.com.

IMPORTANT	**DO NOT PLUG A MODEM OR ANY OTHER PC-COMPATIBLE SERIAL DEVICE INTO THE 9-PIN CONNECTOR OF THE CIO-EN!**

Modbus/RTU Master Device I/O Port

The Modbus/RTU master device must be equipped with an RS-485 port. If the master device has only RS-232 ports and/or USB ports, converters are fairly inexpensive and easy to find. When selecting a converter, ensure that the master device can obtain control of the Request-To-Send (RTS) line or that the converter automatically turns on the RS-485 line whenever a command is being sent.

Modbus/RTU Default Communication Parameters

The default Modbus/RTU communications parameters are:

Parameter Name	Parameter Value
777-P/P1 Baud Rate	9600
CIO-EN Baud Rate	19200
Parity	Even
Data Bits	8
Stop Bits	1
777-P/P1 Modbus Address	1
CIO-EN Modbus Address	1 if standalone Flex if connected to 777-P/P1 (same as 777-P/P1)

Modbus Memory and Data Location Terminology / Register vs. Address

The Modbus standard defines a memory location in terms of registers and addresses. The "register" numbering system starts Xxxxxx1 and goes up to X65536, where the leading X is a reference number that designates a register type. The "address" numbering system starts at 0 rather than 1 and does not contain a prefix. The prefix indicates which read and write functions should be used to get or set the corresponding location. The Modicon Modbus Protocol Reference Guide implements these prefixes as XX references. For example, the prefix of '4X' is used for holding registers in the reference guide. The MODBUS standard that is found at http://www.Modbus-ida.org, however, does not make use of the XX references.

Older standards and products tend to use a 5-digit numbering system for registers. (Ex: 40,001 for the first holding register). Most new documentation, however, is written using a 6-digit numbering system to utilize the fact that Modbus supports registers up to 65536. (Ex: 400,001 for the first holding register).

The "address" numbering system is defined in the standard to describe the message that is actually sent to the physical communications bus. Starting the addresses at 0 rather than 1 and truncating the register type prefix or reference maximizes the number of usable memory or data locations. This document will use the terms "address" and "location" interchangeably to refer to the actual address placed on the bus to get the intended piece of data.

Supported Modbus/RTU Commands

The CIO-EN will respond to four Modbus commands.

1. INSTRUCTION CODE 03 Read Holding Registers - to read a block of words
   The 03 code is used to read data from the CIO-EN and/or 777-P/P1.

2. INSTRUCTION CODE 04 Read Input Registers - to read a block of words
   The 04 code is used to read data from the CIO-EN and/or 777-P/P1.

3. INSTRUCTION CODE 06 Preset Single Register - to write one value
   The 06 code can also be used to modify the setpoints of the CIO-EN and/or 777-P/P1.

4. INSTRUCTION CODE 16 Preset Multiple Registers (777-P/P1 Supports only 1 register write)
   The 16 code is used to modify the setpoints of the CIO-EN and/or 777-P/P1.

Broadcast is not supported.

Modbus/RTU Read Command Example

A typical request for the 777-P/P1 with an attached CIO-EN would be to read the average voltage and 3 line-to-line voltages starting at address 43, or 2B hexadecimal. In the example below, the values will be returned as 481, 476, 483, and 480 for these variables.

Assume that the CIO-EN has been programmed with a Modbus/RTU device address of A02. The Modbus command message from the master device to a slave device would look like:

Byte	Contents	Example (in Hex)
1	Address of Slave Device	02
2	Command to Slave Device	03
3	High Byte of Address	00 (Address of VCA)
4	Low Byte of Address	2B
5	High Byte of Number of Words	00 (Read 4 words)
6	Low Byte of Number of Words	04
7	LOW byte of CRC word	34
8	HIGH byte of CRC word	32

The above sequence would be a request to read 4 words (8 bytes) starting at address 43. The normal response from the slave device to the master device would look something like:

Byte	Contents	Example (in Hex)
1	Address of Slave Device	02
2	Echo of Command to Slave Device	03
3	Number of Bytes sent back	08
4	High Byte of Word at 002C	01 (VCA = 481)
5	Low Byte of Word at 002C	E1
6	High Byte of Word at 002E	01 (VBC = 476)
7	Low Byte of Word at 002E	DC
8	High Byte of Word at 0030	01 (VAB = 483)
9	Low Byte of Word at 0030	E3
10	High Byte of Word at 0032	01 (VAVG = 480)
11	Low Byte of Word at 0032	E0
12	LOW byte of CRC word	8A
13	HIGH byte of CRC word	41

The voltage values listed would be values that might be expected from a 480 volt system.

Note: The CRC (Cyclic Redundancy Check) word is sent with the Low byte first followed by the High byte.

The CRC bytes are sent in a different order from the order of the address and Number-Of-Words-To-Send words. The Address and Number-Of-Words-To-Send words are sent with the high byte first followed by the low byte.

Modbus/RTU Write Command Example

If a CIO-EN has been programmed with a device address of A01, the command to turn off an attached 777-P/P1's fault relay would be:

Byte	Contents	Example (in Hex)
1	Address of Slave Device	01
2	Command to Slave Device	06
3	High Byte of Address	00 (Address of COMLINE)
4	Low Byte of Address	64
5	High Byte of Value to write	00 (Sending STOP command)
6	Low Byte of Value to write	DD
7	LOW byte of CRC word	08
8	HIGH byte of CRC word	4C

The above sequence would be a request to write 1 byte starting at address 100, or 64 hexadecimal, which is the address of the command word, COMLINE. Refer to Appendix A – 777-P/P1 Modbus Memory Maps for more information about 777-P/P1 commands.

The normal response from the CIO-EN is an echo of the same byte sequence back to the master device. This is a confirmation that the command was properly executed.

Modbus/RTU CRC Testing

CRC calculations may be verified by generating the above STOP command and comparing the generated CRC bytes with the CRC bytes listed above. Sending the above command string should result in the 777-P/P1's display showing "oFF". The 777-P/P1 will ONLY respond correctly if the CRC bytes, along with the first six bytes, are identical to the above sequence. Invalid CRC bytes received by the 777-P/P1 will result in a communication error and the 777-P/P1 will NOT turn off its relay.

NOTE: If an oscilloscope is used to capture the sequence of bits that are being transmitted, note that the MODBUS RTU mode specifies that the LEAST significant bit of each byte is transmitted first. The sequence above would begin with a start bit, followed by the bit sequence: high, low, low, low, low, low, low, low, parity, stop for the first byte (01 hex) sent.

Similarly, the command to reset a 777-P/P1 with an attached CIO-EN would be:

Byte	Contents	Example (in Hex)
1	Address of Slave Device	01
2	Command to Slave Device	06
3	High Byte of Address	00 (Address of COMLINE)
4	Low Byte of Address	64
5	High Byte of Value to write	00 (Sending RESET command)
6	Low Byte of Value to write	AA
7	LOW byte of CRC word	48
8	HIGH byte of CRC word	6A

Number of Write Operations

The setpoints in the CIO-EN and 777-P/P1 are stored in non-volatile memory, meaning there are a finite number of writes allowed before the memory is unable to store new values. SymCom recommends that no more than 100,000 writes be performed on non-volatile memory locations. The CIO-EN and 777-P/P1 setpoints can be read indefinitely without degradation of the non-volatile memory.

Special Notes When Using the 4X Addresses

Some software packages, such as Human-Machine-Interface (HMI) software packages for PLCs, can only utilize the registers from 400001 to 465536 in the Modbus 03 and 06 commands. If this is the case, add 400001 to the addresses in the tables to select the start of the data to read. Many of these software packages will automatically subtract the 400001 from the address before sending the actual address in the Modbus command.

Ethernet Configuration

Relevant Terms and Definitions

Term	Definition	Special Notes
IP Address	A numerical identification assigned to devices that are designed to communicate in a computer network using IP (Internet Protocol).	The CIO-EN's default IP address is 192.168.50.1.
Subnet Mask	A mask that identifies which part of an IP address is reserved for the network and which part is available for host use. This mask helps determine which subnet an IP address is on.	The CIO-EN's default subnet mask is 255.255.0.0. A router with the IP address of 192.168.X.X would be on the same subnet as a CIO-EN with default settings.
Gateway	A gateway is a node on a network that serves as an entrance to another network.	The CIO-EN's default gateway address is 192.168.50.1.
NetBIOS Name	NetBIOS is an acronym for Network Basic Input/Output System. It is an identifier assigned by an administrator to identify devices by name on a local area network.	The CIO-EN's default NetBIOS Name is *CIO_EN*.
MAC Address	A Media Access Control (MAC) address is an identifier assigned to most network adapters by the manufacturer for identification.	The CIO-EN's MAC address is located on a label on the backside of the CIO-EN. All of SymCom's MAC addresses begin with the following three octets: 0x00 (0), 0x21 (33), 0x6F (111)
DHCP	Dynamic Host Configuration Protocol (DHCP) is a method devices use to obtain necessary parameters in order to correctly operate in an IP network. It is basically an automatic configuration system, allowing for little or no manual setup.	DHCP is disabled by default on the CIO-EN.
10Base-T	Ethernet connection that supports 10 Mbps (Megabits/second) transmission speed.	The CIO-EN supports 10Base-T connectivity.
Crossover Cable	An external crossover cable is used to directly connect an Ethernet device to a computer.	An external crossover cable must be used to connect the CIO-EN directly to a computer because both the computer and the CIO-EN do not have internal crossover circuitry.
Straight Cable	A straight cable is used to directly connect an Ethernet device to a LAN network.	The CIO-EN is capable of connecting directly to a LAN via an Ethernet straight cable. This cable does not use the crossover technique.

Default Ethernet Communications Settings

The default Ethernet communications settings for the CIO-EN are:

- IP Address:
  - 192.168.50.1 as standalone
  - 192.168.50.FLEX where FLEX = 777-P/P1 Modbus Address
- Subnet Mask: 255.255.0.0
- Gateway: 192.168.50.1
- DHCP: Disabled

General Tips for Ethernet Communication

1.) By default, Microsoft Windows automatically uses a different client port number when generating client requests to CIO-EN sockets (FTP, HTTP, Modbus, etc.). If the connection is lost and restored between the computer and the CIO-EN while a socket is open, the CIO-EN will attempt to respond to the computer's port even if the computer has sent a new message from a different port; this means the computer will not receive the CIO-EN's response. Fortunately, the CIO-EN has a built in socket watchdog for each socket (default = 2 minutes). Once a socket watchdog timer expires, the socket is closed and new socket connections are accepted by the CIO-EN. Typically, closing the browser/command prompt/Solutions will and restarting the program will allow for immediate reconnection to a socket.

2.) Attempting to open an HTTP/Modbus/FTP socket before the computer has connected to a device may result in a failure to connect to the CIO-EN. The safest method of connecting to the CIO-EN via Ethernet is to wait until the computer has connected to the CIO-EN.

3.) The CIO-EN does not support the following network properties:
   a. Client for Microsoft Networks
   b. File and Printer Sharing for Microsoft Networks
   c. QoS Packet Scheduler

   If these properties are enabled, the CIO-EN may be unnecessarily flooded with messages and network traffic that could cause communications problems.

Supported TCP/IP Protocols

There are many common TCP/IP protocols that are supported by the CIO-EN. Each protocol supported by the CIO-EN is described in further detail below, along with examples of how each is used. The assumption is made that the user has experience with Microsoft Windows and its TCP/IP capabilities.

Modbus/TCP

The CIO-EN supports Modbus/TCP and adheres to the Modbus/TCP standard. In accordance with the Modbus/TCP standard, the CIO-EN has dedicated port 502 to Modbus/TCP. The Modbus/TCP server is responsible for processing and responding to designated Modbus/TCP requests. Modbus/TCP functions supported by the CIO-EN include:

- Function 0x03 - Read Holding Registers
  - Used to read data from the CIO-EN and/or 777-P/P1.
- Function 0x04 - Read Input Registers
  - Used to read data from the CIO-EN and/or 777-P/P1.
- Function 0x06 - Preset Single Register
  - Used to modify the setpoints of the CIO-EN and/or 777-P/P1.
- Function 0x10 - Preset Multiple Registers (777-P/P1 Supports only 1 register write)
  - Used to modify the setpoints of the CIO-EN and/or 777-P/P1.

Modbus/TCP is very similar to Modbus/RTU. Some of the primary differences between Modbus/RTU and Modbus/TCP include:

- The MODBUS 'slave address' field usually used on MODBUS Serial Line is replaced by a single byte 'Unit Identifier' within the MBAP Header. The 'Unit Identifier' is used to communicate via devices such as bridges, routers and gateways that use a single IP address to support multiple independent MODBUS end units.

- All MODBUS requests and responses are designed in such a way that the recipient can verify that a message is finished. For function codes where the MODBUS PDU has a fixed length, the function code alone is sufficient. For function codes carrying a variable amount of data in the request or response, the data field includes a byte count.

- When MODBUS is carried over TCP, additional length information is carried in the MBAP header (Table 1 – MBAP Header Fields) to allow the recipient to recognize message boundaries even if the message has been split into multiple packets for transmission. The existence of explicit and implicit length rules and use of a CRC-32 error check code (on Ethernet) results in an infinitesimal chance of undetected corruption to a request or response message.

Table 1 – MBAP Header Fields

Fields	**Length**	**Description**	**Client**	**Server**
Transaction Identifier	2 Bytes	Identification of a MODBUS Request / Response transaction.	Initialized by the client	Recopied by the server from the received request
Protocol Identifier	2 Bytes	0 = MODBUS protocol	Initialized by the client	Recopied by the server from the received request
Length	2 Bytes	Number of following bytes	Initialized by the client (request)	Initialized by the server (Response)
Unit Identifier	1 Byte	Identification of a remote slave connected on a serial line or on other buses. **Always 255**	Initialized by the client	Recopied by the server from the received request

The CIO-EN Modbus/TCP server will only respond to messages with a Unit Identifier of 255 and will not send a response if a timeout occurs when the message was directed to an attached overload. SymCom's Solutions software provides the ability to view and/or configure all of the CIO-EN's real-time parameters and setpoints using Modbus/TCP.

HTTP (Embedded Webpage)

The embedded webpage (Figure 1) can be accessed by typing in the CIO-EN's IP address in the web browser address bar. The NetBIOS name may also be used to access the CIO-EN if it is on a LAN and the NetBIOS name is not duplicated on the LAN. The embedded webpage serves as a method for monitoring the real-time and setpoint values of the CIO-EN and connected overload. In addition, the embedded webpage provides the ability to change the CIO-EN's configuration settings.

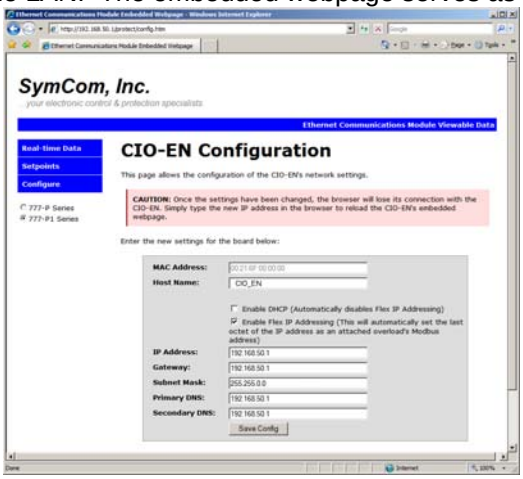

Figure 1 - Embedded Webpage

To change the Ethernet configuration settings, simply type the IP address of the CIO-EN in the address bar of an Internet browser (i.e. http://192.168.50.1/) and click on *Configure*. The CIO-EN will ask for the following user name and password:

- User Name: *admin*
- Password: *symcom*

The NetBIOS name, IP address, gateway, subnet mask, DHCP status, and flexible IP addressing are among the settings that may be configured using the embedded webpage. ***Note:*** *The embedded webpage uses Java AJAX to continuously refresh data; therefore, older browsers may not be able to display the webpage correctly.*

FTP (File Transfer Protocol)

If logging has been properly configured, the CIO-EN is capable of storing data log files. These log files can be viewed and saved by uploading them from an FTP client. To retrieve a data log file in Microsoft Windows, perform the following steps (Figure 2):

1.) Open the Command Prompt (Start…Run…cmd)
2.) Type *ftp IP Address* (i.e. ftp 192.168.50.1)
3.) Enter the following user name and password:
    - User Name: *admin*
    - Password: *symcom*
4.) To view a listing of the files available, type *dir*
5.) A listing of the files will appear. To save a file to the current working directory, type *get FileName* (i.e. get 091808.sym)
    - *Note: The file names are listed in the following format: MMDDYY.sym*
6.) To close the FTP connection, type *quit*

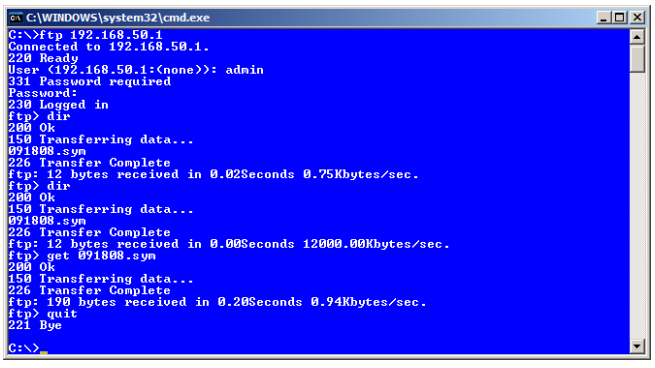

Figure 2 - Retrieving a File

All CIO-EN log files are comma delimited and can be easily opened and viewed in Microsoft Excel. SymCom's Solutions software provides additional advanced log file data processing and storage options not available in Microsoft Excel. Logging data is described in more detail after the CIO-EN memory map.

The FTP socket connection will automatically disconnect if it has not received a message for an extended period of time (see: FTP socket watchdog in memory map). ***Note:*** *The CIO-EN FTP server MUST be accessed through the command prompt and NOT Microsoft Windows or Internet browsers directly.*

ICMP (Ping)

A useful feature provided by the CIO-EN for troubleshooting Ethernet connectivity issues is the ICMP, or ping, function. To attempt a ping of a CIO-EN (Figure 3), open the Command Prompt (Start…Run…cmd) and type *ping IP_Address* (i.e. 192.168.50.1). Diagnostic results of the ping will be displayed on the screen.

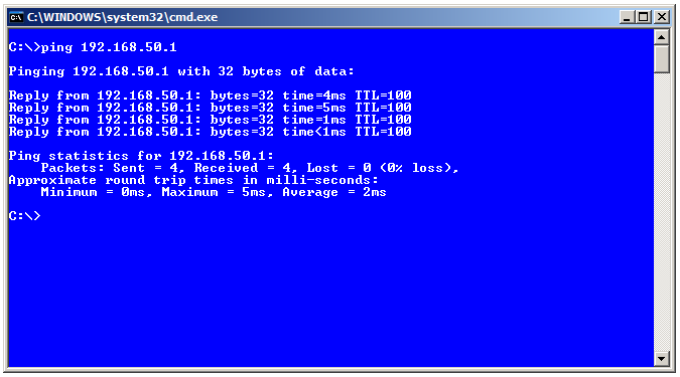

Figure 3 - ICMP Example

CIO-EN Modbus Memory Map

Table 2 - CIO-EN Modbus Memory Map

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
0x2400	9216	49217	R	N/A	N/A	Device Status Bits	Bit 0: Trip status Bit 1: Warning status Bit 2: Output A logic Bit 3: Output B logic Bit 4: Input 1 logic Bit 5: Input 2 logic Bit 6: Input 3 logic Bit 7: Input 4 logic Bit 8: Remote reset status Bit 9: CIO-Overload Comm. Watchdog Trip Bit 10: Network-CIO Comm. Watchdog Trip Bit 11: CIO-Overload Comm. Status Bit 12: Ethernet-CIO Comm. Watchdog Trip Bit 13: Ethernet Link Status
0x2401	9217	49218	R	N/A	N/A	Software Revision	The revision of the software in the CIO-EN
0x2402	9218	49219	R	N/A	N/A	Product Identifier	Product ID of the CIO • CIO-EN = 3000 • CIO-EN = 3100
0x2403	9219	49220	R	N/A	N/A	777-P/P1 Average Current	Raw current read from the overload multiplied by 10
0x2404	9220	49221	R	N/A	N/A	777-P/P1 L1 Current	Raw current read from the overload multiplied by 10
0x2405	9221	49222	R	N/A	N/A	777-P/P1 L2 Current	Raw current read from the overload multiplied by 10
0x2406	9222	49223	R	N/A	N/A	777-P/P1 L3 Current	Raw current read from the overload multiplied by 10
0x2407	9223	49224	R	N/A	N/A	777-P/P1 Ground Fault Current	Raw current read from the overload multiplied by 10
0x2408	9224	49225	R/W	0	25443	Real-time clock year/month	The year and month of the embedded real-time clock. The high byte is the year; the low byte is the month.
0x2409	9225	49226	R/W	0	25443	Real-time clock day/hour	The day and hour of the embedded real-time clock. The high byte is the day; the low byte is the month.
0x240A	9226	49227	R/W	0	25407	Real-time clock minute/second	The minute and second of the embedded real-time clock. The high byte is the minute; the low byte is the second.
0x240B	9227	49228	R	N/A	N/A	Power Off Year	The year when the last power off event occurred
0x240C	9228	49229	R	N/A	N/A	Power Off Month	The month when the last power off event occurred
0x240D	9229	49230	R	N/A	N/A	Power Off Day	The day when the last power off event occurred
0x240E	9230	49231	R	N/A	N/A	Power Off Hour	The hour when the last power off event occurred
0x240F	9231	49232	R	N/A	N/A	Power Off Minute	The minute when the last power off event occurred
0x2410	9232	49233	R	N/A	N/A	Power Off Second	The second when the last power off event occurred
0x2411	9233	49234	R	N/A	N/A	Number of Logging Files	The number of logging files stored in the device
0x2412	9234	49235	R/W	0	3	Digital Output Control Bits	Bit 0: Output A Bit 1: Output B
0x2413	9235	49236	R/W	0	7	Digital Output 'On' Control Bits	Setting any of the following bits will turn the corresponding output 'On' without affecting the state of the other outputs Bit 0: 1 = Output A On Bit 1: 1 = Output B On Bit 2: 1 = Reset Fault Relay
0x2414	9236	49237	R/W	0	7	Digital Output 'Off' Control Bits	Setting any of the following bits will turn the corresponding output 'Off' without affecting the state of the other outputs Bit 0: 1 = Output A Off Bit 1: 1 = Output B Off Bit 2: 1 = Turn off Fault Relay
0x2415	9237	49238	R/W	0	2047	Network communication configuration bits	Bit 0: 1 = Parity is transmitted (Network-CIO) Bit 1: 1 = Even Parity, 0 = Odd Parity (Network-CIO) Bit 2: 1 = 19200 Baud, 0 = 9600 Baud (Network-CIO) With High Baud Range Enabled, 1 = 57600 Baud, 0 = 38400 Baud Bit 3: 1 = High Baud Range Select Bit 4: 1 = Front Porch Enabled Bit 5: 1 = Back Porch Enabled Bit 6: 1 = Parity is transmitted (CIO-Overload) Bit 7: 1 = Even Parity, 0 = Odd Parity (CIO-Overload) Bit 8: 1 = 19200 Baud, 0 = 9600 Baud (CIO-Overload) Bit 9: 1 = Modbus/RTU Flex Addressing Enabled Bit 10: 1= TCP/IP Flex Addressing Enabled
0x2416	9238	49239	R/W	0	65535	Back Porch Time	Back porch time delay (For advanced users only)
0x2417	9239	49240	R/W	0	65535	Front Porch Time	Front porch time delay (For advanced users only)
0x2418	9240	49241	R/W	1	255	Network Modbus	Modbus address of the CIO (default = 1)

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
						address	
0x2419	9241	49242	R/W	1	255	Back Door address	Back door Modbus address of the CIO (default = 127)
0x241A	9242	49243	R/W	1	255	Overload Modbus address	Modbus address of attached 777-P/P1 (default = 1)
0x241B	9243	49244	R/W	0	3	Output invert control bits	Bit 0: 1 = Invert Output A operation Bit 1: 1 = Invert Output B operation
0x241C	9244	49245	R/W	0	3	Output A control functionality	0 = Value set over network only 1 = Value set by link to fault status 2 = Value set by link to warning status 3 = Value set by logic block
0x241D	9245	49246	R/W	0	3	Output B control functionality	0 = Value set over network only 1 = Value set by link to fault status 2 = Value set by link to warning status 3 = Value set by logic block
0x241E	9246	49247	R/W	0	3	Input 1 control functionality	0 = Report value only 1 = Use as remote reset 2 = Use as remote trip 3 = Use as inhibit setting for 777-P/P1
0x241F	9247	49248	R/W	0	2	Input 2 control functionality	0 = Report value only 1 = Use as remote reset 2 = Use as remote trip
0x2420	9248	49249	R/W	0	2	Input 3 control functionality	0 = Report value only 1 = Use as remote reset 2 = Use as remote trip
0x2421	9249	49250	R/W	0	2	Input 4 control functionality	0 = Report value only 1 = Use as remote reset 2 = Use as remote trip
0x2422	9250	49251	R/W	0	2	Remote reset control functionality	0 = Use as remote reset 1 = Use as general input only (report value only) 2 = Use as remote trip
0x2423	9251	49252	R/W	0	65535	Fault Link Mask A	Fault link mask for Output A
0x2424	9252	49253	R/W	0	65535	Fault Link Mask B	Fault link mask for Output B
0x2425	9253	49254	R/W	0	65535	Warning Link Mask A[3]	Warning link mask for Output A
0x2426	9254	49255	R/W	0	65535	Warning Link Mask B[3]	Warning link mask for Output B
0x2427	9255	49256	R/W	0	31	Logic Block 'OR' Mask A	Output A 'OR' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x2428	9256	49257	R/W	0	31	Logic Block 'OR' Mask B	Output B 'OR' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x2429	9257	49258	R/W	0	31	Logic Block 'AND' Mask A	Output A 'AND' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x242A	9258	49259	R/W	0	31	Logic Block 'AND' Mask B	Output B 'AND' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x242B	9259	49260	R/W	0	31	Logic Block 'NOR' Mask A	Output A 'NOR' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x242C	9260	49261	R/W	0	31	Logic Block 'NOR' Mask B	Output B 'NOR' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x242D	9261	49262	R/W	0	31	Logic Block 'NAND' Mask A	Output A 'NAND' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
0x242E	9262	49263	R/W	0	31	Logic Block 'NAND' Mask B	Output B 'NAND' Mask Bit 0: Input 1 Bit 1: Input 2 Bit 2: Input 3 Bit 3: Input 4 Bit 4: Remote Reset Input
0x242F	9263	49264	R/W	0	15	Logic Block 'CMB' Mask A	Output A 'CMB' Mask Bit 0: OR Bit 1: NOR Bit 2: AND Bit 3: NAND Combines logic functions
0x2430	9264	49265	R/W	0	15	Logic Block 'CMB' Mask B	Output B 'CMB' Mask Bit 0: OR Bit 1: NOR Bit 2: AND Bit 3: NAND Combines logic functions
0x2431	9265	49266	R/W	0	65535	Inhibit Mask[3]	777-P/P1 Inhibit mask for Input 1
0x2432	9266	49267	W	0	7	CIO Configuration Bits	Bit 0: 1 = Reset settings to defaults Bit 1: 1 = Reset min/max values[2] Bit 2: 1 = Reset file system[1]
0x2433	9267	49268	R/W	0	63	Watchdog Trip Control Bits	Bit 0: 1 = Network-CIO Comm. restored, send START command to overload Bit 1: 1 = Network-CIO Comm. watchdog, send OFF command to overload Bit 2: 1 = Network-CIO Comm. watchdog, turn off Output B Bit 3: 1 = Network-CIO Comm. watchdog, turn off Output A Bit 4: 1 = CIO-Overload Comm. watchdog, turn off Output B Bit 5: 1 = CIO-Overload Comm. watchdog, turn off Output A Bit 6: 1 = Ethernet-CIO Comm. restored, send START command to overload Bit 7: 1 = Ethernet-CIO Comm. watchdog, send OFF command to overload Bit 8: 1 = Ethernet-CIO Comm. watchdog, turn off output B Bit 9: 1 = Ethernet-CIO Comm. watchdog, turn off output A
0x2434	9268	49269	R/W	0	15	Real-time Storage Block Configuration	Bit 0: 1 = Real-time Block 1 stored in CIO-EN RAM Bit 1: 1 = Real-time Block 2 stored in CIO-EN RAM Bit 2: 1 = Real-time Block 3 stored in CIO-EN RAM Bit 3: 1 = Real-time Block 4 stored in CIO-EN RAM Storing real-time data from an attached overload in the RAM of the CIO-EN decreases latency in upstream Modbus requests.
0x2435	9269	49270	R/W	0	65535	Real-time Block 1 Start Address	The starting Modbus address at which real-time block 1 requests data from an attached overload
0x2436	9270	49271	R/W	0	30	Real-time Block 1 Number of Words	The number of words that are requested for storage in real-time block 1
0x2437	9271	49272	R/W	0	65535	Real-time Block 2 Start Address	The starting Modbus address at which real-time block 2 requests data from an attached overload
0x2438	9272	49273	R/W	0	30	Real-time Block 2 Number of Words	The number of words that are requested for storage in real-time block 2
0x2439	9273	49274	R/W	0	65535	Real-time Block 3 Start Address	The starting Modbus address at which real-time block 3 requests data from an attached overload
0x243A	9274	49275	R/W	0	30	Real-time Block 3 Number of Words	The number of words that are requested for storage in real-time block 3
0x243B	9275	49276	R/W	0	65535	Real-time Block 4 Start Address	The starting Modbus address at which real-time block 4 requests data from an attached overload
0x243C	9276	49277	R/W	0	30	Real-time Block 4 Number of Words	The number of words that are requested for storage in real-time block 4
0x243D	9277	49278	R/W	0	15	Limit Storage Block Configuration	Bit 0: 1 = Limit Block 1 stored in CIO-EN RAM Bit 1: 1 = Limit Block 2 stored in CIO-EN RAM Bit 2: 1 = Limit Block 3 stored in CIO-EN RAM Bit 3: 1 = Limit Block 4 stored in CIO-EN RAM Storing limit data from an attached overload in the RAM of the CIO-EN decreases latency in upstream Modbus requests.
0x243E	9278	49279	R/W	0	65535	Limit Block 1 Start Address	The starting Modbus address at which limit block 1 requests data from an attached overload
0x243F	9279	49280	R/W	0	30	Limit Block 1 Number of Words	The number of words that are requested for storage in limit block 1

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
0x2440	9280	49281	R/W	0	65535	Limit Block 2 Start Address	The starting Modbus address at which limit block 2 requests data from an attached overload
0x2441	9281	49282	R/W	0	30	Limit Block 2 Number of Words	The number of words that are requested for storage in limit block 2
0x2442	9282	49283	R/W	0	65535	Limit Block 3 Start Address	The starting Modbus address at which limit block 3 requests data from an attached overload
0x2443	9283	49284	R/W	0	30	Limit Block 3 Number of Words	The number of words that are requested for storage in limit block 3
0x2444	9284	49285	R/W	0	65535	Limit Block 4 Start Address	The starting Modbus address at which limit block 4 requests data from an attached overload
0x2445	9285	49286	R/W	0	30	Limit Block 4 Number of Words	The number of words that are requested for storage in limit block 4
0x2446	9286	49287	R/W	0	65535	Fault Register Modbus Address	The Modbus address of the register that contains the attached overload fault status (777-P/P1 Default = 0x0006 *Trip Reason*)
0x2447	9287	49288	R/W	0	65535	Pending Fault Register Modbus Address	The Modbus address of the register that contains the attached overload pending fault status (777-P/P1 Default = 0x0005 *Overload Status*)
0x2448	9288	49289	R/W	0	65535	Warning Status Register Modbus Address[3]	The Modbus address of the register that contains the attached overload warning status (777-P/P1 Default = 0x001C *Warning Status*)
0x2449	9289	49290	R/W	0	65535	Command Line Register Modbus Address	The Modbus address of the register that is used for start/stop commands in the overload (777-P/P1 Default = 0x0064 *Command Line*)
0x244A	9290	49291	R/W	0	65535	Command Line – Start Command	The START command sent to an overload via the command line (777-P/P1 Default = 0x00AA)
0x244B	9291	49292	R/W	0	65535	Command Line – Stop Command	The STOP command sent to an overload via the command line (777-P/P1 Default = 0x00DD)
0x244C	9292	49293	R/W	10	65535	Modbus TCP Socket Watchdog	The amount of idle seconds allowed on the Modbus socket before the socket is reset
0x244D	9293	49294	R/W	10	65535	FTP Socket Watchdog	The amount of idle seconds allowed on the FTP socket before the socket is reset
0x244E	9294	49295	R/W	0	31	Log Status Configuration	Logging Configuration Bits Bit 0: 1 = Log 777-P/P1 Faults Bit 1: 1 = Log 777-P/P1 Pending Faults Bit 2: 1 = Log Assembly Parameters Bit 3: 1 = Log CIO-EN Power Events Bit 4: 1 = Log 777-P/P1 Comm. Events
0x244F	9295	49296	R/W	15	255	Log Interval	The minimum amount of seconds in between parameter log events
0x2450	9296	49297	R/W	4	31	Log Threshold Configuration – Parameter 1	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2451	9297	49298	R/W	4	31	Log Threshold Configuration – Parameter 2	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2452	9298	49299	R/W	4	31	Log Threshold Configuration – Parameter 3	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2453	9299	49300	R/W	4	31	Log Threshold Configuration –	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
						Parameter 4	least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2454	9300	49301	R/W	4	31	Log Threshold Configuration – Parameter 5	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2455	9301	49302	R/W	4	31	Log Threshold Configuration – Parameter 6	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2456	9302	49303	R/W	4	31	Log Threshold Configuration – Parameter 7	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2457	9303	49304	R/W	4	31	Log Threshold Configuration – Parameter 8	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2458	9304	49305	R/W	4	31	Log Threshold Configuration – Parameter 9	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x2459	9305	49306	R/W	4	31	Log Threshold Configuration – Parameter 10	Log Threshold Configuration Bits Bit 1: 1 = Log this parameter if its value has changed by at least the amount specified by the parameter's corresponding "Value Change" setting Bit 2: 1 = If this parameter is logged, log all parameters in the log parameter assembly Bit 3: 1 = Log this parameter if its value is equal the parameter's corresponding threshold setting Bit 4: 1 = Log this parameter if its value is greater than the parameter's corresponding threshold setting Bit 5: 1 = Log this parameter if its value is less than the parameter's corresponding threshold setting
0x245A	9306	49307	R/W	0	65535	Log Threshold Value – Parameter 1	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
0x245B	9307	49308	R/W	0	65535	Log Threshold Value – Parameter 2	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x245C	9308	49309	R/W	0	65535	Log Threshold Value – Parameter 3	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x245D	9309	49310	R/W	0	65535	Log Threshold Value – Parameter 4	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x245E	9310	49311	R/W	0	65535	Log Threshold Value – Parameter 5	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x245F	9311	49312	R/W	0	65535	Log Threshold Value – Parameter 6	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x2460	9312	49313	R/W	0	65535	Log Threshold Value – Parameter 7	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x2461	9313	49314	R/W	0	65535	Log Threshold Value – Parameter 8	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x2462	9314	49315	R/W	0	65535	Log Threshold Value – Parameter 9	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x2463	9315	49316	R/W	0	65535	Log Threshold Value – Parameter 10	The threshold value that is used to determine if the parameter is logged (see Log Threshold Configuration Bits)
0x2464	9316	49317	R/W	0	65535	Log Assembly Location – Parameter 1	The Modbus location of the parameter to log
0x2465	9317	49318	R/W	0	65535	Log Assembly Location – Parameter 2	The Modbus location of the parameter to log
0x2466	9318	49319	R/W	0	65535	Log Assembly Location – Parameter 3	The Modbus location of the parameter to log
0x2467	9319	49320	R/W	0	65535	Log Assembly Location – Parameter 4	The Modbus location of the parameter to log
0x2468	9320	49321	R/W	0	65535	Log Assembly Location – Parameter 5	The Modbus location of the parameter to log
0x2469	9321	49322	R/W	0	65535	Log Assembly Location – Parameter 6	The Modbus location of the parameter to log
0x246A	9322	49323	R/W	0	65535	Log Assembly Location – Parameter 7	The Modbus location of the parameter to log
0x246B	9323	49324	R/W	0	65535	Log Assembly Location – Parameter 8	The Modbus location of the parameter to log
0x246C	9324	49325	R/W	0	65535	Log Assembly Location – Parameter 9	The Modbus location of the parameter to log
0x246D	9325	49326	R/W	0	65535	Log Assembly Location – Parameter 10	The Modbus location of the parameter to log
0x246E	9326	49327	R/W	0	65535	Log Value Change Setting – Parameter 1	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x246F	9327	49328	R/W	0	65535	Log Value Change Setting – Parameter 2	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2470	9328	49329	R/W	0	65535	Log Value Change Setting – Parameter 3	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2471	9329	49330	R/W	0	65535	Log Value Change Setting – Parameter 4	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2472	9330	49331	R/W	0	65535	Log Value Change Setting – Parameter 5	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2473	9331	49332	R/W	0	65535	Log Value Change Setting – Parameter 6	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2474	9332	49333	R/W	0	65535	Log Value Change Setting –	The amount the parameter's value must change between readings in order for the value to be logged (see Log

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
						Parameter 7	Threshold Configuration Bits)
0x2475	9333	49334	R/W	0	65535	Log Value Change Setting – Parameter 8	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2476	9334	49335	R/W	0	65535	Log Value Change Setting – Parameter 9	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2477	9335	49336	R/W	0	65535	Log Value Change Setting – Parameter 10	The amount the parameter's value must change between readings in order for the value to be logged (see Log Threshold Configuration Bits)
0x2478	9336	49337	R/W	0	65535	Modbus Assembly 502 Parameter 1	Modbus register to access in Modbus Assembly 502
0x2479	9337	49338	R/W	0	65535	Modbus Assembly 502 Parameter 2	Modbus register to access in Modbus Assembly 502
0x247A	9338	49339	R/W	0	65535	Modbus Assembly 502 Parameter 3	Modbus register to access in Modbus Assembly 502
0x247B	9339	49340	R/W	0	65535	Modbus Assembly 502 Parameter 4	Modbus register to access in Modbus Assembly 502
0x247C	9340	49341	R/W	0	65535	Modbus Assembly 502 Parameter 5	Modbus register to access in Modbus Assembly 502
0x247D	9341	49342	R/W	0	65535	Modbus Assembly 502 Parameter 6	Modbus register to access in Modbus Assembly 502
0x247E	9342	49343	R/W	0	65535	Modbus Assembly 502 Parameter 7	Modbus register to access in Modbus Assembly 502
0x247F	9343	49344	R/W	0	65535	Modbus Assembly 502 Parameter 8	Modbus register to access in Modbus Assembly 502
0x2480	9344	49345	R/W	0	65535	Modbus Assembly 502 Parameter 9	Modbus register to access in Modbus Assembly 502
0x2481	9345	49346	R/W	0	65535	Modbus Assembly 502 Parameter 10	Modbus register to access in Modbus Assembly 502
0x2482	9346	49347	R/W	0	65535	Modbus Assembly 502 Parameter 11	Modbus register to access in Modbus Assembly 502
0x2483	9347	49348	R/W	0	65535	Modbus Assembly 502 Parameter 12	Modbus register to access in Modbus Assembly 502
0x2484	9348	49349	R/W	0	65535	Modbus Assembly 502 Parameter 13	Modbus register to access in Modbus Assembly 502
0x2485	9349	49350	R/W	0	65535	Modbus Assembly 502 Parameter 14	Modbus register to access in Modbus Assembly 502
0x2486	9350	49351	R/W	0	65535	Modbus Assembly 502 Parameter 15	Modbus register to access in Modbus Assembly 502
0x2487	9351	49352	R/W	0	65535	Modbus Assembly 502 Parameter 16	Modbus register to access in Modbus Assembly 502
0x2488	9352	49353	R/W	0	65535	Modbus Assembly 502 Parameter 17	Modbus register to access in Modbus Assembly 502
0x2489	9353	49354	R/W	0	65535	Modbus Assembly 502 Parameter 18	Modbus register to access in Modbus Assembly 502
0x248A	9354	49355	R/W	0	65535	Modbus Assembly 502 Parameter 19	Modbus register to access in Modbus Assembly 502
0x248B	9355	49356	R/W	0	65535	Modbus Assembly 502 Parameter 20	Modbus register to access in Modbus Assembly 502
0x248C	9356	49357	R/W	0	65535	Modbus Assembly 502 Parameter 21	Modbus register to access in Modbus Assembly 502
0x248D	9357	49358	R/W	0	65535	Modbus Assembly 502 Parameter 22	Modbus register to access in Modbus Assembly 502

16 Bit Modbus Address			R/W	Lower Limit	Upper Limit	Description	Notes
Hex	Dec	Modicon					
0x248E	9358	49359	R/W	0	65535	Modbus Assembly 502 Parameter 23	Modbus register to access in Modbus Assembly 502
0x248F	9359	49360	R/W	0	65535	Modbus Assembly 502 Parameter 24	Modbus register to access in Modbus Assembly 502
0x2490	9360	49361	R/W	0	65535	Modbus Assembly 502 Parameter 25	Modbus register to access in Modbus Assembly 502
0x2491	9361	49362	R/W	0	65535	Modbus Assembly 502 Parameter 26	Modbus register to access in Modbus Assembly 502
0x2492	9362	49363	R/W	0	65535	Modbus Assembly 502 Parameter 27	Modbus register to access in Modbus Assembly 502
0x2493	9363	49364	R/W	0	65535	Modbus Assembly 502 Parameter 28	Modbus register to access in Modbus Assembly 502
0x2494	9364	49365	R/W	0	65535	Modbus Assembly 502 Parameter 29	Modbus register to access in Modbus Assembly 502
0x2495	9365	49366	R/W	0	65535	Modbus Assembly 502 Parameter 30	Modbus register to access in Modbus Assembly 502
0x2496	9366	49367	R/W	0	65535	Modbus Assembly 502 Parameter 31	Modbus register to access in Modbus Assembly 502
0x2497	9367	49368	R/W	0	65535	Modbus Assembly 502 Parameter 32	Modbus register to access in Modbus Assembly 502
0x2498	9368	49369	R/W	0	65535	Modbus Assembly 502 Parameter 33	Modbus register to access in Modbus Assembly 502
0x2499	9369	49370	R/W	0	65535	Modbus Assembly 502 Parameter 34	Modbus register to access in Modbus Assembly 502
0x249A	9370	49371	R/W	0	65535	Modbus Assembly 502 Parameter 35	Modbus register to access in Modbus Assembly 502
0x249B	9371	49372	R/W	0	65535	Modbus Assembly 502 Parameter 36	Modbus register to access in Modbus Assembly 502
0x249C	9372	49373	R/W	0	65535	Modbus Assembly 502 Parameter 37	Modbus register to access in Modbus Assembly 502
0x249D	9373	49374	R/W	0	65535	Modbus Assembly 502 Parameter 38	Modbus register to access in Modbus Assembly 502
0x249E	9374	49375	R/W	0	65535	Modbus Assembly 502 Parameter 39	Modbus register to access in Modbus Assembly 502
0x249F	9375	49376	R/W	0	65535	Modbus Assembly 502 Parameter 40	Modbus register to access in Modbus Assembly 502
					Notes:	[1] *May not be available in all models* [2] *Reserved for future use* [3] *Only applicable for 777-P1*	

Real-time Values

Device Status Bits

The device status bits display status information about the CIO-EN and an attached overload (if applicable). Table 3 defines each bit in the device status register.

Table 3 - Network Communication Configuration Bits

Bit	Name	Description
0	Trip status	1 = an attached overload has tripped due to a fault
1	Warning status	1 = an attached overload has a warning
2	Output A logic	0 = Output A is opened 1 = Output A is closed
3	Output B logic	0 = Output B is opened 1 = Output B is closed
4	Input 1 logic	0 = Input 1 is off 1 = Input 1 is on
5	Input 2 logic	0 = Input 2 is off 1 = Input 2 is on
6	Input 3 logic	0 = Input 3 is off 1 = Input 3 is on
7	Input 4 logic	0 = Input 4 is off 1 = Input 4 is on
8	Remote reset status	0 = Remote reset input is off 1 = Remote reset input is on
9	CIO-Overload comm. watchdog trip	1 = A 5 second communications watchdog has occurred between the CIO and attached overload
10	Network-CIO comm. watchdog trip	1 = A 5 second communications watchdog has occurred between the CIO and an upstream Modbus/RTU device
11	CIO-Overload comm. status	1 = The CIO is successfully communicating with an attached overload
12	Ethernet-CIO Comm. Watchdog Trip	1 = A 5 second communications watchdog has occurred between the CIO and an upstream Ethernet device
13	Ethernet Link Status	1 = The CIO is connected to an Ethernet network

Overload Currents

The CIO-EN provides real-time current values read from an attached overload (if applicable) that are always scaled by 10. This provides current values that are scaled by a fixed value, eliminating the need for the user to manually scale the currents by the adjustable scalar native to the overload. As an important note, the overload's scalar and current register addresses *must* be stored in the real-time configuration blocks (discussed later in this document) in order for them to update correctly.

Network Communication

Network Communication Configuration Bits

The network communication configuration bits provide configuration for the CIO-EN serial communication settings. The default values and their descriptions are listed in Table 4.

Table 4 - Network Communication Configuration Bits

Bit	Default Setting	Description
0	1	1 = a parity bit is expected in Network-CIO communications
1	1	1 = even parity is expected in Network-CIO communications 0 = odd parity is expected in Network-CIO communications Note: Bit 0 must be set to enable Bit 1
2	0	0 = 9600 Baud rate in Network-CIO communications (38400 with High Baud Range enabled) 1 = 19200 Baud rate in Network-CIO communications (57600 with High Baud Range enabled)
3	0	0 = High Baud Range Disabled 1 = High Baud Range Enabled
4	1	1 = Network-CIO communications front porch enabled (linked to front porch time setting)
5	1	1 = Network-CIO communications back porch enabled (linked to back porch time setting)
6	1	1 = a parity bit is transmitted in CIO-Overload communications
7	1	1 = even parity is transmitted in CIO-Overload communications 0 = odd parity is transmitted in CIO-Overload communications Note: Bit 5 must be set to enable Bit 6
8	0	0 = 9600 Baud rate in CIO-Overload communications 1 = 19200 Baud rate in CIO-Overload communications
9	1	1 = Modbus/RTU Flexible addressing enabled
10	1	1 = TCP/IP Flex Addressing enabled

Note: The settings for the CIO-EN must match the settings for the network and for the overload in order to establish communication. Changing CIO-EN communications settings may affect upstream and/or downstream communications.

Front/Back Porch Times

A communications front porch is simply a method of biasing a communications signal before actually transmitting a message. Biasing the communications signal provides the intended receiver with an indication that a message is being sent; this allows the receiver time to prepare for message reception. A back porch works in a similar fashion, signaling the end of a message. The front and back porch time settings represent character times as opposed to actual time values, and should not be changed unless required.

Modbus/RTU Flexible Addressing

By default, Modbus/RTU flexible addressing is enabled in the CIO-EN. This means that the address of the CIO-EN will always automatically match the Modbus address of an attached overload. Disabling flexible addressing could result in the CIO-EN and attached overload having different Modbus addresses.

TCP/IP Flexible Addressing

The default IP address for the CIO-EN is 192.168.50.1. However, flexible IP addressing is enabled by default on the CIO-EN. This means that when the CIO-EN is connected and communicating to a 777-P/P1 overload relay, the CIO-EN will automatically assume and keep the Modbus address of the overload as the last octet in its IP address. For example, if the CIO-EN is connected to a 777-P/P1 with a Modbus address of 29, the IP address will automatically become 192.168.50.29. Please note that the first three octets of the IP address (192.168.50) are not affected by flexible IP addressing.

I/O Functionality

Digital Output Control

The states of the output relays can be changed at any time from a Modbus master. Bit 0 provides network control over Output A and bit 1 provides network control over Output B. As an important note, network control is overridden when outputs are linked to logic, fault status, or warning status.

Digital Output 'On' Control

The digital output 'on' control register provides the ability to turn on an output relay without affecting the state of the other outputs. Bit 0 provides network control over Output A, bit 1 provides network control over Output B, and bit 2 provides network control over an attached 777-P/P1. As an important note, network control is overridden when outputs are linked to logic, fault status, or warning status.

Digital Output 'Off' Control

The digital output 'off' control register provides the ability to turn off an output relay without affecting the state of the other outputs. Bit 0 provides network control over Output A, bit 1 provides network control over Output B, and bit 2 provides network control over an attached 777-P/P1. As an important note, network control is overridden when outputs are linked to logic, fault status, or warning status.

Output Invert Control Bits

The output invert control register provides the ability to invert the logic of the output relays. Setting bit 0 inverts the logic of output A and setting bit 1 inverts the logic of output B.

Output Functionality

Each output relay may be configured to operate in one of the four modes described in Table 5.

Table 5 - Output Functions

Value	Function	Description
0	Value set over network only	Output changes only when a network command to change it is received.
1	Value set by link to fault status	Output associated with fault register value and fault link mask). Output changes when any of the masked fault register bits are set.
2	Value set by link to warning status[1]	Output associated with warning status register value and warning link mask. Output changes when any of the masked warning status register bits are set.
3	Value set by Logic Block	Output changes only when the associated logic block conditions are met (described in detail in the Logic Block Configuration section below)
Notes:		*[1] Only applicable for 777-P1*

Input Functionality

Each input may be configured to operate in one of the modes described in Table 6.

Table 6 - Input Functions

Value	Function	Description
0	Report value only	The input is configured to only report its value in the Device Status register.
1	Use as remote reset	The input is configured to send a START command to the overload's command line when the input reads high.
2	Use as remote trip	The input is configured to send an OFF command to the overload's command line when the input reads high.
3[1]	Use as inhibit setting for 777-P/P1	Input 1 is linked to the Inhibit Bits in the 777-P/P1 with the Inhibit Mask. The overload will not trip when the input reads high and any of the masked bits are set.
Notes:		*[1] Function only available for use with Input 1*

Remote Reset Functionality

The remote reset may be configured to operate in one of the modes described in Table 7.

Table 7 - Remote Reset Functions

Value	Function	Description
0	Use as remote reset	The remote reset is configured to send a START command to the overload's command line when activated.
1	Use as general input only (report value only)	The remote reset is configured to only report its value in the Device Status register.
2	Use as remote trip	The remote reset is configured to send an OFF command to the overload's command line when activated.

Fault and Warning Link Mask Configuration

Fault Link Mask

The fault link mask is only utilized when the output control functionality is linked to fault status. A bitwise AND operation is performed between the fault link mask and the value retrieved from the fault register. If the result of the AND is greater than 0, the corresponding relay is turned on; otherwise, the relay is turned off.

Warning Link Mask

The warning link mask is only utilized when the output control functionality is linked to warning status. A bitwise AND operation is performed between the warning link mask and the value retrieved from the warning status register. If the result of the AND is greater than 0, the corresponding relay is turned on; otherwise, the relay is turned off. The warning link mask is only applicable for 777-P1.

Logic Block Configuration

Setting for Logic Block OR mask

If all bits are ZERO, the OR function is ignored (OR function value is 0). If any bit is set to 1 and the corresponding input pin reads high, the OR function value is 1.

Table 8 - Logic Block OR

Bit Number	Associated Input
Bit 0	Input 1
Bit 1	Input 2
Bit 2	Input 3
Bit 3	Input 4
Bit 4	Remote Reset Input

Setting for Logic Block NOR mask

If all bits are ZERO, the NOR function is ignored (NOR function value is 0). If any bit is set to 1 and the corresponding COMPLEMENTED input pin reads high, (i.e. the input pin itself reads low) the NOR function value is 1.

Table 9 - Logic Block NOR

Bit Number	Associated Input
Bit 0	Input 1
Bit 1	Input 2
Bit 2	Input 3
Bit 3	Input 4
Bit 4	Remote Reset Input

Setting for Logic Block AND mask

If all bits are ZERO, the AND function is ignored (AND function value is 0). If all bits that are set to 1 match the value (high) of the corresponding input pins, the AND function value is 1.

Table 10 - Logic Block AND

Bit Number	Associated Input
Bit 0	Input 1
Bit 1	Input 2
Bit 2	Input 3
Bit 3	Input 4
Bit 4	Remote Reset Input

Setting for Logic Block NAND mask

If all bits are ZERO, the NAND function is ignored (NAND function value is 0). If all bits that are set to 1 match the value (high) of the corresponding COMPLEMENTED input pins, the NAND function value is 1.

Table 11 – Logic Block NAND

Bit Number	Associated Input
Bit 0	Input 1
Bit 1	Input 2
Bit 2	Input 3
Bit 3	Input 4
Bit 4	Remote Reset Input

Setting for Logic Block COMBINATION mask

If any bit is ZERO, the corresponding outputs of the logic blocks are OR'ed together. If the result is high, the COMBINATION function value is 1. If all bits that are set to 1 match the value (high) of the corresponding logic block, the COMBINATION function value is 1.

Table 12 – Logic Block CMB

Bit Number	Associated Logic Operation
Bit 0	OR function
Bit 1	NOR function
Bit 2	AND function
Bit 3	NAND function

Inhibit Mask Configuration

Inhibit Mask

The inhibit mask is used only when Input 1 control functionality is set to “Use as inhibit setting for 777-P/P1”. The inhibit mask is directly linked to the 777-P/P1’s Inhibit Bits register. Setting any of the mask bits high enables Input 1 to inhibit the overload from tripping on that corresponding fault.

CIO Configuration

Reset settings to defaults

Setting bit 0 will reset all CIO-EN limit/setpoint data to factory default values.

Note – setting this bit will erase all existing CIO-EN settings!

Watchdog Trip Control Configuration

Watchdog Trip Control Bits

The functionality of the watchdog trip control bits is described in Table 13.

Table 13 – Watchdog Trip Control Bits

Bit	Function	Description
0	Network-CIO Comm. restored, send START command to overload	The CIO-EN will send a START command to the attached overload when communication is reestablished over the network.
1	Network-CIO Comm. watchdog, send OFF command to overload	The CIO-EN will send an OFF command to the attached overload when communication is lost over the network.
2	Network-CIO Comm. watchdog, turn off Output B	The CIO-EN will turn off Output B when communication has been lost over the network for at least 5 seconds.
3	Network-CIO Comm. watchdog, turn off Output A	The CIO-EN will turn off Output A when communication has been lost over the network for at least 5 seconds.
4	CIO-Overload Comm. watchdog, turn off Output B	The CIO-EN will turn off Output B when communication has been lost with the overload for at least 5 seconds.
5	CIO-Overload Comm. watchdog, turn off Output A	The CIO-EN will turn off Output A when communication has been lost with the overload for at least 5 seconds.
6	Ethernet-CIO Comm. restored, send START command to overload	The CIO-EN will send a START command to the attached overload when Ethernet communication is reestablished.
7	Ethernet-CIO Comm. watchdog, send OFF command to overload	The CIO-EN will send an OFF command to the attached overload when Ethernet communication is lost.
8	Ethernet-CIO Comm. watchdog, turn off output B	The CIO-EN will turn off Output B when Ethernet communication has been lost for at least 15 seconds.
9	Ethernet-CIO Comm. watchdog, turn off output A	The CIO-EN will turn off Output A when Ethernet communication has been lost for at least 15 seconds.

Storage Block Configuration

Storage Block Configuration

Real-time and limit/setpoint data from an attached overload may be stored in the CIO-EN's RAM to minimize Modbus response latency. Modbus messages that require data from the overload not stored in the CIO-EN's RAM must be passed through to the overload, increasing the response time. The CIO-EN provides four 30 word RAM blocks dedicated for real-time data and four 30 word RAM blocks dedicated for limit/setpoint data. Each block has an associated Modbus starting address and number of words to be read from the overload. Table 14 describes the storage block configuration bits for both the real-time and limit data.

Table 14 – Storage Block Configuration Bits

Bit	Function	Description
0	Block 1 stored in CIO-EN RAM	Setting this bit to a 1 will store all the values corresponding to the addresses configured in block 1 to the CIO-EN RAM.
1	Block 2 stored in CIO-EN RAM	Setting this bit to a 1 will store all the values corresponding to the addresses configured in block 2 to the CIO-EN RAM.
2	Block 3 stored in CIO-EN RAM	Setting this bit to a 1 will store all the values corresponding to the addresses configured in block 2 to the CIO-EN RAM.
3	Block 4 stored in CIO-EN RAM	Setting this bit to a 1 will store all the values corresponding to the addresses configured in block 3 to the CIO-EN RAM.

Note: Do not attempt to store any of the CIO-EN's Modbus addresses in the real-time/limit storage blocks. These blocks are designated specifically to store data from the overload.

Customizable Addresses/Commands

Customizable Addresses

The CIO-EN provides the user with a way to customize certain addresses for ease of use. The Fault Register, Warning Status Register, and Command Line Register can all be changed. The default addresses are shown in the CIO-EN Memory Map.

Note: These registers should be changed by advanced users only.

Customizable Commands

The CIO-EN allows the user to change the commands to stop and start the overload. These commands are linked to the Command Line Register, and the defaults are listed in the CIO-EN Memory Map.

Real-time Clock

The CIO-EN has a built-in clock that is used for logging. It is set when shipped, but can be changed.

Logging

Log Status Configuration

The log status configuration bits can be set to log various events according to Table 13.

Table 13 – Ethernet Characteristics and Descriptions

Bit	Function	Description
0	Log Faults	1 = The CIO-EN will store the time and type of any faults that occur according to the overload's fault register.
1	Log Pending Faults	1 = The CIO-EN will store the time and type of any pending faults that occur according to the overload's pending fault register.
2	Log Parameters	1 = The CIO-EN will store the parameter's data according to the conditions set in the log assembly fields.
3	Log Power Events	1 = The CIO-EN will log a power event if it loses power. It will also log an event when the CIO-EN powers up.
4	Log Comm Events	1 = The CIO-EN will log a comm. event if it loses communication with the overload.

Log Interval

The log interval defines the amount of time in seconds between each log of parameter data by the CIO-EN. 15 seconds is the minimum interval that can be entered. Faults, pending faults, power events, and comm. events are logged instantaneously as they occur.

Log Threshold Configurations

The log threshold configuration determines whether the data corresponding to the log assembly register will be logged by comparing the register's value to the log threshold value. The configuration can be set to log when the value is greater than, less than, and/or equal to the log threshold value.

Log Threshold Values

The log threshold value is the value used by the log threshold configuration to determine whether logging will occur for the data corresponding to the log assembly register.

Log Assembly Locations

The log assembly locations can be any Modbus address that pertains to the CIO-EN or the overload. They are denoted as log assembly registers. These locations must also exist in the real-time or limit storage blocks (discussed above).

Log Value Change Settings

The log value change function can be enabled by setting bit 0 in the corresponding log assembly to 1. If it is set to a 1, the log assembly value change is taken into account. If the value change setting is equal to 0, the corresponding parameter will always be logged. Setting this value to anything besides 0 requires the parameter data to change at least the amount set between readings in order to be logged.

Log File Format

Log files are stored in the file system using the following naming convention: MMDDYY.sym. Each data entry is stored in the notation below, where each field requires 1 byte. Data for up to 10 parameters may be stored in each parameter entry.

Number of Entry Bytes	Hour	Minute	Second	Event Code	Parameter Address X High	Parameter Address X Low	Parameter Data X High	Parameter Data X Low

The following event codes are used when logging data:

Code	Description
0	Parameter Data
1	Power Off Event
2	Power On Event
3	Comm. Restored Event
4	Comm. Failure Event
5	A fault occurred
6	A pending fault occurred
7	A warning occurred

Modbus Assembly Parameters

Modbus Assembly 502 Parameter 1-40

The Modbus assembly allows the master to read up to 40 setpoints and real-time data in any order independent of the published memory map. Each Modbus assembly parameter represents a Modbus address, and the value can be read via Modbus register 502. The number of parameters returned in a Modbus 0x03 read is specified by the number of registers read. All overload data must be stored in the CIO-EN's internal RAM via the real-time/limit storage blocks described above.

Appendix A – 777-P/P1 Modbus Memory Maps

Run Time Information (777-P and 777-P1)

16 Bit Modbus Address			Code and Description	Notes
Hex	Dec	Modicon		
0x01	1	40002	Major: Minor Software Revision 777-P 777-HVR-P 777-575-P 777-LR-P 777-HVR-LR-P 777-575-LR-P 777-MV-P 777-KW/HP-P 777-575-KW/HP-P 777-HVR-KW/HP-P 777-LR-KW/HP-P 601-CS (601-CS-D)	 0xrr04 0xrr27 0xrr05 0xrr02 0xrr07 0xrr08 0xrr38 0xrr47 0xrr50 0xrr52 0xrr48 0xrr70
0x02	2	40003	Product Code 777-P 777-HVR-P 777-575-P 777-LR-P 777-HVR-LR-P 777-575-LR-P 777-MV-P 777-KW/HP-P 777-575-KW/HP-P 777-HVR-KW/HP-P 777-LR-KW/HP-P 601-CS (601-CS-D)	 1 2 3 11 12 13 31 41 43 42 51 70
0x03	3	40004	MODELCD Model Code	
0x04	4	40005	Current Scale Factor	10 or 100
0x05	5	40006	OLSTAT OLSTAT bits	Bit 0: LV detected Bit 1: HV detected Bit 2: VUB detected Bit 3: UC detected or LPR[1] Bit 4: RP detected Bit 5: CUB detected Bit 6: vSP detected Bit 7: cSP detected Bit 8: OC detected Bit 9: GF detected Bit 10: HPR detected[1] Bit 11: LCV detected Bit 12: ABC Phase Rotation[3] Bit 13: Reserved[2] Bit 14: Global Warning[3] Bit 15: Fault Relay Closed
0x06	6	40007	TRIPRN Trip Reason bits	Bit 0: Man. Reset required Bit 1: Off command issued Bit 2: Tripped on CF Bit 3: Tripped on UC or LPR[1] Bit 4: Tripped on OC Bit 5: Tripped on GF Bit 6: Tripped on CUB Bit 7: Tripped on cSP Bit 8: Tripped on PTC Bit 9: Tripped on Hpr[1] Bit 10: Tripped on LCV Bit 11: Reserved[2] Bit 12: Reserved[2] Bit 13: Reserved[2] Bit 14: Reserved[2] Bit 15: Reserved[2]

16 Bit Modbus Address			Code and Description	Notes
Hex	Dec	Modicon		
0x07	7	40008	LF1 Last Fault	Code Definition 0 Cleared 1 Reserved[2] 2 Reserved[2] 4 Contactor Failure 6 Single Phased Current 7 Ground Fault 8 Current Unbalance 9 Reserved[2] 10 Overcurrent 11 Undercurrent 12 Reserved[2] 13 Reserved[2] 14 Reserved[2] 15 Low Kilowatt Trip (Low Power)[1] 16 PTC Off 17 High Kilowatt Trip (High Power)[1] 18 Reserved[2] 19 Low control voltage trip
0x08	8	40009	LF2 Second to Last Fault	Code Definition 0 Cleared 1 Reserved[2] 2 Reserved[2] 4 Contactor Failure 6 Single Phased Current 7 Ground Fault 8 Current Unbalance 9 Reserved[2] 10 Overcurrent 11 Undercurrent 12 Reserved[2] 13 Reserved[2] 14 Reserved[2] 15 Low Kilowatt Trip (Low Power)[1] 16 PTC Off 17 High Kilowatt Trip (High Power)[1] 18 Reserved[2] 19 Low control voltage trip
0x09	9	40010	LF3 Third to Last Fault	Code Definition 0 Cleared 1 Reserved[2] 2 Reserved[2] 4 Contactor Failure 6 Single Phased Current 7 Ground Fault 8 Current Unbalance 9 Reserved[2] 10 Overcurrent 11 Undercurrent 12 Reserved[2] 13 Reserved[2] 14 Reserved[2] 15 Low Kilowatt Trip (Low Power)[1] 16 PTC Off 17 High Kilowatt Trip (High Power)[1]

16 Bit Modbus Address			Code and Description	Notes
Hex	Dec	Modicon		
				18 Reserved[2] 19 Low control voltage trip
0x0A	10	40011	LF4 Fourth to Last Fault	Code Definition 0 Cleared 1 Reserved[2] 2 Reserved 4 Contactor Failure 6 Single Phased Current 7 Ground Fault 8 Current Unbalance 9 Reserved[2] 10 Overcurrent 11 Undercurrent 12 Reserved[2] 13 Reserved[2] 14 Reserved[2] 15 Low Kilowatt Trip (Low Power)[1] 16 PTC Off 17 High Kilowatt Trip (High Power)[1] 18 Reserved[2] 19 Low control voltage trip
0x0B	11	40012	RD1R Remaining RD1 time	RD1 (Seconds)=Raw Value/2 RD1 (Minutes)=Raw Value/120
0x0C	12	40013	RD2R Remaining RD2 time	RD2 (Seconds)=Raw Value/2 RD2 (Minutes)=Raw Value/120
0x0D	13	40014	RD3R Remaining RD3 time	RD3 (Seconds)=Raw Value/2 RD3 (Minutes)=Raw Value/120
0x0E	14	40015	Capacity Thermal Capacity Remaining	%
0x0F	15	40016	PFANGLE Power factor angle	Degrees
0x10	16	40017	RTKW Kilowatts	Actual KW=Raw Value/100
0x11	17	40018	GFCUR Ground Fault Current	Actual GF Amps=Raw Value/100
0x12	18	40019	IC Current in Phase C	Actual Amps=Raw Value/Current Scale Factor
0x13	19	40020	IB Current in Phase B	Actual Amps=Raw Value/Current Scale Factor
0x14	20	40021	IA Current in Phase A	Actual Amps=Raw Value/Current Scale Factor
0x15	21	40022	IAVG Average Current	Actual Amps=Raw Value/Current Scale Factor
0x16	22	40023	CUNBAL Current Unbalance	%
0x17	23	40024	VCA Voltage from Phase C to Phase A	Volts
0x18	24	40025	VBC Voltage from Phase B to Phase C	Volts
0x19	25	40026	VAB Voltage from Phase A to Phase B	Volts
0x1A	26	40027	VAVG	Volts

16 Bit Modbus Address			Code and Description	Notes
Hex	Dec	Modicon		
			Average Voltage	
0x1B	27	40028	VUNBAL Voltage Unbalance	%
0x1C	28	40029	WarnStat[3] Warning Status Register	Bit 0:LV Warning Bit 1:HV Warning Bit 2:VUB Warning Bit 3:OC Warning Bit 4:UC Warning Bit 5:CUB Warning Bit 6:GF Warning Bit 7:Reserved Bit 8:Low Frequency Warning Bit 9:High Frequency Warning
0x1D	29	40030	Measured Line Frequency[3]	Hz * 10
1. Applies to 777-XXX-KW/HP-P *2. Reserved bits state is undefined* *3. Available only on P1 series*				

Limit (Setpoint) Values (777-P and 777-P1)

16 Bit Modbus Address			Code and Description	Range	Default
Hex	Dec	Modicon			
0x64	100	40101	ComLine Command Line	0x33: PTC Fault and Turn Model 777 OFF 0x44: Enable Network Programming 0x55: Disable Network Programming 0x66: Clear Motor Run Hours 0x77: Clear Last Fault 0x88: Enable Network Watchdog Timer 0x99: Disable Network Watchdog Timer 0xAA: Reset Model 777 0xDD: Turn Model 777 OFF	0
0x66	102	40103	Divisor Divisor	1-255	1
0x67	103	40104	MULT Multiplier	1-255	1
0x68	104	40105	GF Ground Fault 777-xxx-P 777-xxx-LR-P 777-xxx-P1	 .30-640 Amps .15-640 Amps .07-20 Amps	 10 1 10 Amps
0x69	105	40106	UC Under Current 777-xxx-P 777-xxx-LR-P	 .5-1120.0 Amps .10-1120.0 Amps	 35 3.5
0x6A	106	40107	OC Over Current 777-xxx-P 777-xxx-LR-P	 1.0-1120.0 Amps .10-1120.0 Amps	 60 6.0
0x6B	107	40108	CUB Current Unbalance	2-25 %,Off (255)	7
0x6C	108	40109	TC Trip Class	2-100	10
0x6D	109	40110	LV Low Voltage 777 777-HVR 777-575 777-MV	 170-524 Volts 340-523 Volts 450-649 Volts 85-262 Volts	200
0x6E	110	40111	HV High Voltage 777 777-HVR 777-575 777-MV	 172-528 Volts 172-528 Volts 451-660 Volts 86-264 Volts	500
0x6F	111	40112	VUB Voltage Unbalance	2-15 %,Off (255)	6
0x73	115	40116	RD1 Rapid Cycling Restart Delay	0-500 seconds	10
0x74	116	40117	RD2 Restart Delay after OC	2-500 seconds	8

			fault		
0x75	117	40118	RD3 Restart Delay after UC fault	2-500 seconds, A (65535)	20
0x76	118	40119	UCTD Under Current Trip Delay	2-255s	5
0x77	119	40120	#RU Number of restarts after UC fault	0, 1, 2, 3, 4, A (automatic) **RU Values** 0–4 0–4 A 255	1
0x78	120	40121	#RF Number of restarts after OC,cSP,CUB,LCV,HPR[1] fault	0, 1, oc1, 2, oc2, 3, oc3, 4, oc4, A, ocA 0 = manual, A = continuous, oc = automatic restart after RD2 expires **RF Value** **Decimal Value** 0 1 1 2 oc1 3 2 4 oc2 5 3 6 oc3 7 4 8 oc4 9 A 10 ocA 11	OC1
0x79	121	40122	ADDR Modbus device address	1-255	1
0x7A	122	40123	ComParam Communication Parameter Bits	**Communications Value** 9600,N,1 0x18 9600,E,1 0x1B 9600,O,1 0x19 19200,N,1 0x1C 19200,E,1 0x1F 19200,O,1 0x1D	9600,E,1
0x7B	123	40124	ENDIS Enable/Disable bits	Bit 0: GF Trip Enabled Bit 1: VUB Trip Enabled Bit 2: CUB Trip Enabled Bit 3: UC Trip Enabled Bit 4: OC Trip Enabled[2] Bit 5: Reserved[4] Bit 6: LPR Trip Enabled[1] Bit 7: HPR Trip Enabled[1]	15
0x7C	124	40125	NETST Network Status bits	Bit 0: Network Watchdog Enabled Bit 1: Network Program Disabled Bit 2: Front panel locked Bit 3: Reserved[4] Bit 4: Reserved[4] Bit 5: Reserved[4]	0

				Bit 6: Reserved[4] Bit 7: Reserved[4]	
0x7D	125	40126	MRH Motor Run Hours	0-65535 Hours	0
0x80	128	40129	LKW[1] Low Kilowatt Trip Limit	Off (0),.01-655.35 KW	0
0x81	129	40130	HKW[1] High KW trip limit	.01-655.34 KW,Off (65535)	65535
0x82	130	40131	KWS[1] KW Scale Factor	0-4=LKW displayed as KW 5-8=LKW displayed as HP	2
0x83	131	40132	LCV_DLY Low Control Voltage Trip Delay	1-120 seconds	2
0x84	132	40133	LCV_Pcnt Low Control Voltage Percentage	0-120 %	80
0x85	133	40134	cfgCtrl Configuration Control bits	Bit 0: UCTD/LPRTD in minutes Bit 1: RD1 in minutes Bit 2: RD2 in minutes Bit 3: RD3 in minutes Bit 4: HPR TD in minutes[1] Bit 5: Reserved[4] Bit 6: Single phase voltage device Bit 7: Single phase current device Bit 8: Disable RP hold-off Bit 9: Enable low control voltage trip Bit 10: Stall 1 Enable[2] Bit 11: Stall 2 Enable[2] Bit 12: BAC Phase Rotation not at fault Bit 13: RD1 invoked on power up[2] Bit 14: RD1 invoked on current loss[2] Bit 15: Enable emergency run	RD2=Minutes RD3=Minutes RD1 invoked on power up RD1 invoked on current loss
0x87	135	40136	LIN Linear OC Trip Delay	0-254 ½ seconds, Off (255)	Off
0x8D	141	40142	CUBTD CUB Time Delay	1-240	60
0x8E	142	40143	MACtrl Motor Acceleration Control Bits	Bit 0: Reserved[4] Bit 1: Reserved[4] Bit 2: Motor acceleration trip delay applies to CF trip Bit 3: Motor acceleration trip delay applies to UC/LPR trip Bit 4: Reserved[4] Bit 5: Motor acceleration trip delay applies to GF trip Bit 6: Motor acceleration trip delay applies to CUB trip Bit 7: Motor acceleration trip delay applies to cSP trip	0

				Bit 8:Reserved[4] Bit 9: Motor acceleration trip delay applies to HKW trip[1] Bit 10: Motor acceleration trip delay applies to LCV trip Bit 11: Reserved[4] Bit 12: Reserved[4] Bit 13: Reserved[4] Bit 14: Reserved[4] Bit 15: Reserved[4]	
0x8F	143	40144	MATD Motor Acceleration Time Delay	0-255 ½ seconds	0
0x90	144	40145	HPRTD[1] High Power Trip Delay	0-255 seconds	5
0x91	145	40146	StrCntU Start Count Upper Byte	0 Starts	0
0x92	146	40147	StrCntHL Start Count High: Low Bytes	0 Starts	0
0x93	147	40148	StrDur1U Start Duration 1 Upper Byte	0 Minutes	0
0x94	148	40149	StrDur1HL Start Duration 1 High: Low Byte	0 Minutes	0
0x95	149	40150	StrDur2U Start Duration 2 Upper Byte	0 Minutes	0
0x96	150	40151	StrDur2HL Start Duration 2 High: Low Byte	0 Minutes	0
0x97	151	40152	StrDur3U Start Duration 3 Upper Byte	0 Minutes	0
0x98	152	40153	StrDur3HL Start Duration 3 High: Low Byte	0 Minutes	0
0x99	153	40154	StrDur4U Start Duration 4 Upper Byte	0 Minutes	0
0x9A	154	40155	StrDur4HL Start Duration 4 High: Low Byte	0 Minutes	0
0x9B	155	40156	HotOCPer Hot Overcurrent Percentage	1-115%	100
0x9C	156	40157	Backdoor Modbus address	0-255	127
0xA1	157	40158	Inhibit Bits	Bit 0: Reserved Bit 1: Reserved Bit 2: Inhibit CF Trip Bit 3: Inhibit UC/LPR Trip[1] Bit 4: Inhibit OC Trip Bit 5: Inhibit GF Trip Bit 6: Inhibit CUB Trip Bit 7: Inhibit cSP Trip Bit 8: Inhibit HPR Trip[1] Bit 9: Reserved Bit 10: Inhibit LCV Trip	0

0xA2	158	40159	Warn Enable Bits	Bit 0: Enable LV Warning Bit 1: Enable HV Warning Bit 2: Enable VUB Warning Bit 3: Enable OC Warning Bit 4: Enable UC Warning Bit 5: Enable CUB Warning Bit 6: Enable GF Warning Bit 7:Reserved Bit 8:Enable Low Frequency Warning[2] Bit 9:Enable High Frequency Warning[2]	0
0xA3	159	40160	LV Warn Delay	0-255 ½ seconds	0
0xA4	160	40161	HV Warn Delay	0-255 ½ seconds	0
0xA5	161	40162	VUB Warn Delay	0-255 ½ seconds	0
0xA6	162	40163	OC Warn Delay	0-255 ½ seconds	0
0xA7	163	40164	UC Warn Delay	0-255 ½ seconds	0
0xA8	164	40165	CUB Warn Delay	0-255 ½ seconds	0
0xA9	165	40166	GF Warn Delay	0-255 ½ seconds	0
0xAA	166	40167	LV Warn Setpoint	0-65535 Volts	200 Volts
0xAB	167	40168	HV Warn Setpoint	0-65535 Volts	400 Volts
0xAC	168	40169	VUB Warn Setpoint	0-255%	5 %
0xAD	169	40170	OC Warn Setpoint	(0-65535 / Scale Factor) Amps	50 Amps
0xAE	170	40171	UC Warn Setpoint	(0-65535 / Scale Factor) Amps	40 Amps
0xAF	171	40172	CUB Warn Setpoint	0-255%	5 %
0xB0	172	40173	GF Warn Setpoint	(0-65535 / 1000) Amps	1 Amps
0xB1	173	40174	Stall 1 Trip Delay	0-255 ½ seconds	0
0xB2	174	40175	Stall 1 Inhibit Delay	0-255 ½ seconds	0
0xB3	175	40176	Stall 1 Percentage	0-65535 %	0 %
0xB4	176	40177	Stall 2 Trip Delay	0-255 ½ seconds	0
0xB5	177	40178	Stall 2 Inhibit Delay	0-255 ½ seconds	0
0xB6	178	40179	Stall 2 Percentage	0-65535 %	0 %
0xB7	179	40180	Ground Fault Trip Delay	0-251	16
0xB8	180	40181	High Frequency Warn Setpoint[2]	0-100 * 10 Hz	70 Hz
0xB9	181	40182	Low Frequency Warn Setpoint[2]	0-100 * 10 Hz	50 Hz
0xBA	182	40183	GF CT Ratio[2]	0-10000	1250/500
0xBB	183	40184	Voltage Hold-Off Enable[2]	Bit 0:Low voltage hold-off enabled Bit 1:High voltage hold-off enabled Bit 2:VUB hold-Off Enabled Bit 3:Reserved Bit 4:Reverse phase hold-off enabled Bit 5:Reserved Bit 6:Voltage single phase hold-off enabled Bit 7:Reserved	B'01010111'

				Bit 8:Reserved Bit 9:Reserved Bit 10:Reserved Bit 11:Reserved Bit 12:Reserved Bit 13:Reserved Bit 14:Reserved Bit 15:Reserved	
0x2153	8530	48531	MBAssembly500Wrd0	0-255	2
0x2154	8531	48532	MBAssembly500Wrd1	0-255	3
0x2155	8532	48533	MBAssembly500Wrd2	0-255	4
0x2156	8533	48534	MBAssembly500Wrd3	0-255	5
0x2157	8534	48535	MBAssembly500Wrd4	0-255	6
0x2158	8535	48536	MBAssembly500Wrd5	0-255	7
0x2159	8536	48537	MBAssembly500Wrd6	0-255	8
0x215A	8537	48538	MBAssembly500Wrd7	0-255	9
0x215B	8538	48539	MBAssembly500Wrd8	0-255	10
0x215C	8539	48540	MBAssembly500Wrd9	0-255	11
0x215D	8540	48541	MBAssembly500Wrd10	0-255	12
0x215E	8541	48542	MBAssembly500Wrd11	0-255	13
0x215F	8542	48543	MBAssembly500Wrd12	0-255	14
0x2160	8543	48544	MBAssembly500Wrd13	0-255	15
0x2161	8544	48545	MBAssembly500Wrd14	0-255	16
0x2162	8545	48546	MBAssembly500Wrd15	0-255	17
0x2163	8546	48547	MBAssembly500Wrd16	0-255	18
0x2164	8547	48548	MBAssembly500Wrd17	0-255	19
0x2165	8548	48549	MBAssembly500Wrd18	0-255	20
0x2166	8549	48550	MBAssembly500Wrd19	0-255	21
0x2167	8550	48551	MBAssembly500Wrd20	0-255	22
0x2168	8551	48552	MBAssembly500Wrd21	0-255	23
0x2169	8552	48553	MBAssembly500Wrd22	0-255	24
0x216A	8553	48554	MBAssembly500Wrd23	0-255	25
0x216B	8554	48555	MBAssembly500Wrd24	0-255	26
0x216C	8555	48556	MBAssembly500Wrd25	0-255	27
0x216D	8556	48557	MBAssembly500Wrd26	0-255	28
0x216E	8557	48558	MBAssembly500Wrd27	0-255	29
0x216F	8558	48559	MBAssembly500Wrd28	0-255	30
0x2170	8559	48560	MBAssembly500Wrd29	0-255	31
0x2171	8560	48561	MBAssembly500Wrd30	0-255	102
0x2172	8561	48562	MBAssembly500Wrd31	0-255	103
0x2173	8562	48563	MBAssembly500Wrd32	0-255	104
0x2174	8563	48564	MBAssembly500Wrd33	0-255	105
0x2175	8564	48565	MBAssembly500Wrd34	0-255	106
0x2176	8565	48566	MBAssembly500Wrd35	0-255	107
0x2177	8566	48567	MBAssembly500Wrd36	0-255	108
0x2178	8567	48568	MBAssembly501Wrd0	0-255	109
0x2179	8568	48569	MBAssembly501Wrd1	0-255	110
0x217A	8569	48570	MBAssembly501Wrd2	0-255	111
0x217B	8570	48571	MBAssembly501Wrd3	0-255	112
0x217C	8571	48572	MBAssembly501Wrd4	0-255	113
0x217D	8572	48573	MBAssembly501Wrd5	0-255	114
0x217E	8573	48574	MBAssembly501Wrd6	0-255	115

0x217F	8574	48575	MBAssembly501Wrd7	0-255	116
0x2180	8575	48576	MBAssembly501Wrd8	0-255	117
0x2181	8576	48577	MBAssembly501Wrd9	0-255	118
0x2182	8577	48578	MBAssembly501Wrd10	0-255	119
0x2183	8578	48579	MBAssembly501Wrd11	0-255	120
0x2184	8579	48580	MBAssembly501Wrd12	0-255	121
0x2185	8580	48581	MBAssembly501Wrd13	0-255	122
0x2186	8581	48582	MBAssembly501Wrd14	0-255	123
0x2187	8582	48583	MBAssembly501Wrd15	0-255	124
0x2188	8583	48584	MBAssembly501Wrd16	0-255	125
0x2189	8584	48585	MBAssembly501Wrd17	0-255	126
0x218A	8585	48586	MBAssembly501Wrd18	0-255	127
0x218B	8586	48587	MBAssembly501Wrd19	0-255	128
0x218C	8587	48588	MBAssembly501Wrd20	0-255	129
0x218D	8588	48589	MBAssembly501Wrd21	0-255	130
0x218E	8589	48590	MBAssembly501Wrd22	0-255	131
0x218F	8590	48591	MBAssembly501Wrd23	0-255	2
0x2190	8591	48592	MBAssembly501Wrd24	0-255	3

1. Only applies to 777-XXX-KW/HP-P
2. Only applies to P1 series
3. Read only bit
4. Reserved bits should be maintained as 0

Note: For more information about the 777-P/P1, see the programming guide and installation manual for the 777-P/P1. All installation manuals and programming guides are available online at www.symcom.com.